

THE REVIEW

DEVOTED TO THE INTERESTS OF THE AMERICAN SOCIETY FOR METALS

Volume XV

MAY, 1942

No. 5

CONVENTION CITY IS CHANGED TO CLEVELAND

All Activities of Metal Show Will Stress and Aid War Production

The National Metal Congress and the War Production Edition of the National Metal Exposition will be held in Cleveland the week of Oct. 12, rather than in Detroit as originally announced. All buildings in Detroit of sufficient size to house the Show have been requisitioned for war purposes, and the event is therefore scheduled for the Public Auditorium in Cleveland.

Feeling that the National Metal Exposition can be of greater

service to the metal industry and to the country than ever before, the Board of Trustees of the A.S.M. is planning to provide a common meeting place where executives, production men and engineers can discuss ways and means for increased production of war materials.

The general plan, and reasons for the importance of the Cleveland Convention, are outlined in the following statement from the Board:

In this war of metals, hope for Victory rests largely upon America's metal industry.

No industry is better able or more willing to shoulder this responsibility. But let us not deceive ourselves—the task is tremendous—the Victory is vital—it can be brought about only by pooling ideas and information, by accepting and placing in operation every advance and improvement in production methods and equipment so that every war products manufacturer can produce at the utmost speed and efficiency.

As one of the technological forces in the metal industry, the American Society for Metals feels a definite responsibility for continuing and enlarging its educational services in the field of metals. Along with industry it must accept the responsibility for securing maximum production in the minimum amount of time.

Metal Industry Tested by War

It is time to pool ideas and information. It is time to cooperate, to consider the other fellow's viewpoint and his problems, to provide full opportunities for the exchange of experiences, for the cross-checking of all progress for the benefit of the war efforts as a whole, and to prove that America's metal industry can win this Battle of Production.

In order to intensify and speed up the mental approach and thus increase production, there must be:

1. A meeting of executives where the frank disclosure of time-saving developments useful in speeding production can be made available to all.
2. A meeting of top engineers so that design improvements each company has accomplished may become the common property of all.
3. A meeting of production and process men, where findings dealing with the speediest possible methods of getting war products into quantity production may be placed in the hands of all.
4. Material, equipment and process manufacturers must see that their products get full opportunity in the hands of the user to do the jobs they were designed to do. These products—their advantages, operation, intelligent use, conservation and maintenance—must be explained and demonstrated.

Progress In War Production Stressed

Charged with the basic job of war production, the metal industry must meet and seek suggestions for improvement in design, in manufacture and processing that will insure an ever increasing flow of the vital materials for Victory.

The annual meetings of the American
(Continued on page 2)

Silver Brazing Alloys Have Unusually Wide Range of Properties

Reported by Ellis Blade
Consulting Engineer

New York Chapter—On April 13, John L. Christie, of Handy and Harman, presented an absorbing lecture on "Silver Brazing Alloys".

Referring back to origins in antiquity, Mr. Christie said that only 25 years ago engineering data were still scant on these alloys, which began as mere modifications of the metals joined. The present-day compositions consist primarily of the ternary Ag-Cu-Zn alloys with or without additions of Cd, Ni, Mn, Sn, or P.

Silver brazing alloys, formerly called silver solders, must meet an unusual combination of requirements:

1. The joint must be strong. This implies clean melting and good wetting power, as well as strength, toughness, corrosion resistance, and chemical compatibility with the metals joined.
2. The alloy must be economical to produce in the desired form, namely, sheet, strip, wire, rings, flings.
3. The melting range is usually narrowly restricted.
4. Color may be important.
5. Price usually restricts the silver content. The silversmiths' alloys are exceptions in that they must contain sufficient silver for the completed article

(Continued on page 8)

Manufacture of Gun Clips at Arsenal Shown

Reported by James C. Erickson
Deere & Co.

Tri-City Chapter—Paul C. Cunick, civilian in charge of the laboratory, Rock Island Arsenal, addressed the March meeting on "Inspection of Ordnance Materials".

Slides showing the many implements of warfare made at the Arsenal were introduced and comments were made by the speaker from the angle of inspection. Mr. Cunick traced in detail inspection of gun clips from receipt of the strip coils to the final operation on the completed clips. Set-up of inspection procedure for the ordnance districts of the country was described.

In a coffee talk, Lieut. Col. Thomas R. Taber, chief inspector at the Arsenal, warned against complacency in industry and declared that war production should no longer be considered in terms of defense, but in terms of the nation's very existence.

A.S.M. National Officers Are Nominated

IN ACCORDANCE with the Constitution of the American Society for Metals, the Nominating Committee appointed by President Bradley Stoughton met on Monday, May 18, at the Palmer House in Chicago. The Committee consists of James T. MacKenzie, Chairman; I. N. Goff, Clarence H. Lorig, John E. Dorn, Alexander Finlayson, Ray McBrien, and H. L. Hovis.

The following nominations have been made:

President (1 year)—Herbert J. French, In Charge of Alloy Steel and Iron Development, International Nickel Co., New York.

Vice-President (1 year)—Marcus A. Grossmann, Director of Research, Carnegie-Illinois Steel Corp., Chicago.

Secretary (2 years)—William H. Eisenman, 7301 Euclid Ave., Cleveland, Ohio.

Trustees (2 years)—Vsevolod N. Krivobok, Director of Structural Research, Lockheed Aircraft Corp., Burbank, Calif.; and E. G. Hill, Assistant General Superintendent, Gary Works, Carnegie-Illinois Steel Corp.

Tri-Chapter Meeting Features NE Steels

The new National Emergency steels will form the subject of the Southern Ohio Tri-Chapter Meeting of the A.S.M. to be held in Cincinnati on Friday, June 5, with the Columbus, Dayton, and Indianapolis Chapters cooperating.

The meeting will be held in the Netherland-Plaza Hotel, opening at 9:30 a.m. and adjourning at 9:00 p.m. Speakers and subjects are:

EMERGENCY STEELS — WHAT THEY ARE AND WHERE AND HOW THEY SHOULD BE USED, by E. J. Hergenroether, Iron and Steel Branch, Metallurgical and Specifications Section, War Production Board.

FORGINGS OF EMERGENCY STEELS, by Waldemar Naujoks, Steel Improvement and Forge Co.; senior author of "Forging Handbook".

DIE STEELS, by Howard Staggs, vice-president, Halcomb Steel Division, Crucible Steel Co. of America.

GEARS OF EMERGENCY STEELS, by E. F. Davis, Warner Gear Division, Borg-Warner Corp.

HARDENABILITY CONSIDERATIONS OF THE EMERGENCY STEELS, by R. S. Archer, chief metallurgist, Republic Steel Corp., Chicago; past president A.S.M.

Technical chairman for the day and leader of the discussions will be Hans Ernst, director of research, The Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc.

Anyone who would like to attend this meeting and is not on the mailing list of the Cincinnati, Columbus, Dayton or Indianapolis Chapter should get in touch with George H. Gerdes, 6300 Kincaid Rd., Pleasant Ridge, Cincinnati, Ohio. Mr. Gerdes is chairman of the Cincinnati Chapter.

Johns Hopkins Offers Spectrographic Facilities

The Physics Department of Johns Hopkins University has been engaged in work on spectrographic analysis of metals for some time and is anxious to make this work useful to the war effort, according to Prof. G. H. Dieke of the Department of Physics.

Johns Hopkins has a large store of equipment and experience in this field, including 15 spectographs, of which seven are directly suited for spectrographic analysis of metals. The University would be glad to place its facilities at the disposal of firms that could use it to advantage. The staff would be willing to work out difficult problems direct.

Two defense training courses have already been given in the analysis and testing of metals and their alloys, and another is planned for the end of June.

Firms or individuals interested in taking advantage of this offer to aid in the war effort should get in touch with G. H. Dieke, professor of physics, Johns Hopkins University, Baltimore.



Compliments

To Major George M. Enos of the Cincinnati Ordnance District, on his promotion to the rank of lieutenant colonel.

To J. Eugene Jackson, metallurgical engineer with the Copper Iron and Steel Development Association, Cleveland, on his acceptance of a position with the War Production Board as senior industrial analyst, Copper and Brass Division, Inventory and Requisition Section, Division of Industrial Operations.

THE REVIEW General Plan for Cleveland Metal Show Outlined

Published monthly except July and September by the

American Society for Metals
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Subscriptions fifty cents a year; five cents a copy. Entered as Second Class Matter, July 26, 1930, at the Post Office at Cleveland, Ohio, under the Act of March 3, 1879.

RAY T. BAYLESS, Editor
M. R. HYSLOP, Managing Editor

Cleveland, O., May, 1942
Volume XV No. 5

Fine Group of Slides Illustrates Failures

Reported by J. T. Ballard
Quaker Chemical Products Co.

Hartford Chapter—N. L. Deuble, speaking at the March 10th meeting was well qualified to discuss "Service Failures of Steel" by 20 years with United, Central, and Republic Steel Corp.

In 1940 Mr. Deuble left Republic to join Copperweld Steel Co. where he now holds the position of manager of sales.

Mr. Deuble illustrated his talk with a fine assortment of slides, some of diagrams, others showing actual cases of service failures of steel parts such as transmission gears and crankshafts. In several instances photomicrographs of the part which failed were shown directly after the picture of the damaged part itself. In such a fashion the speaker tied in his slides most aptly with his lecture.

The dinner was followed by an excellent coffee talk by James J. Deary, resident agent at Hartford of the Federal Bureau of Investigation. His talk outlined briefly the history of the F.B.I., discussed defense plant protection, and ended with the story of a famous German spy ring case.

(Continued from page 1)

Society for Metals and the annual National Metal Congress held in cooperation with other leading technical societies, have for 24 years served as the common meeting place for the exchange of information and for observing progress in the metal industry.

It is not by mere chance these meetings have been called "the most important annual events in the metal world". They have been justly named. At that time and place gather the outstanding executives, production men, engineers and scientists of the metal field, to confer and to discuss the progress of the year, to observe the developments of new materials, equipment and processes, and to study their application to the individual company's production problems.

No Blackout on Information

War has given these metal men a greater job to do—greater heights to attain. This is a war of metals. Now there is a necessity to produce tanks, planes, guns and ships. With "increased production" the war cry on our industrial battle front, this is not the time to say, "Stay where you are. Do not talk to anyone. Do not compare notes on ways and means. Do not look for new aids to production."

We cannot sit in a dark room, cannot bury our heads in the sand, cannot close our minds to progress and winning the war.

Consequently a responsibility rests with the American Society for Metals and with industry, itself, to continue to afford that established and accepted common meeting place where the metal men of the nation can convene to discuss their problems and plans and examine new and improved aids to increase the production of war material.

The value of this common meeting place is doubly important now when the executive, production and engineering factors in the metal fabricating industry are to a large extent unknown under present fast-changing circumstances. Men trained in other fields have taken places of responsibility in the metal industry. They must be reached—and helped, and this established meeting-place will provide an effective means of communicating with them and presenting a comprehensive picture of the vital factors in equipment, machines, processes and materials that provide and produce the sinews of war.

New Type of Meeting Planned

The experience the American Society for Metals has gained in adjusting its educational activities from peacetime through the defense period to the wartime tempo is assurance that it will have no difficulty in adjusting the annual Congress and displays in the Exposition to contribute to the swifter production of the armed power of America.

These annual meetings have, always been educational and inspirational. This Cleveland meeting will be no exception. New problems will be presented, improved engineering, training new workers, maintenance of present equipment, conservation of scarce metals, substitute materials and many other important and production-hastening topics.

The National Metal Exposition has contributed to the welfare of the metal industry by practical and technical sessions and by illustrating processes, equipment, applications, and services. While the sales angle is necessarily giving way to important and necessary educational features, problems of selection, delivery, and priority ratings continue to require attention.

And all are involved in the question: How can this material, machine, or equipment take its proper place in the production line and help speed our war efforts?

Personal contact on a mass basis is the most effective answer to this question. Therefore, the American Society for Metals will present at Cleveland's Public Auditorium, during the week of Oct. 12 to 16, the National Metal Congress with a War Production Edition of the National Metal Exposition. It will be a 100% educational demonstration clinic devoted to increased production, planning, engineering, improvement of materials, job training, conservation, substitution and maintenance.

New Developments Must Be Put to Work

Display and demonstration and explanation of new or improved materials and equipment will bring each new development to the attention of all, will put products to work where they belong for the benefit of all war production. It will show how a standard product can be adapted to new and timely production. It will create a time saving for all industry that will dwarf

by a thousand-fold the time spent in arranging the display.

The executives, the technical men, the sales engineers in attendance will contribute far more in service to the industry in one week than they could in months of traveling for individual service contacts. The great majority of problems confronting the metal industry today can be answered, explained, or demonstrated quickly by the experienced executive or engineer. Instead of tying up important men or delaying aid to the industry, the War Production display will save the time of all by putting these personal contacts on a mass basis.

Even though a firm's entire output may be under reservations and promised for some time to come, nevertheless if the equipment is shown and it is found that by the use of that material or this machine there can be a speeding up of production, the resulting saving in time will be an effective and worthy service to the country.

If material or equipment is not available for display in this War Production Edition of the National Metal Exposition—and no model or replica of it can be made—there is at least the opportunity to maintain an office and establish contacts at Cleveland where the war production men will assemble and thus through catalogs, blueprints and personal conferences, perform an educational service and assist with all-out aid in the Nation's war effort.

The Board of Trustees of the A.S.M. sincerely believes it has an important, constructive role to continue, and that it would be negligent in its duties in this emergency if it did not accept the responsibility and opportunity to aid in securing war production of maximum quantity, maximum quality, maximum progress, and with maximum efficiency—in the minimum time.

If you serve the metal producing and metal working industries, if you can demonstrate or explain the advantages or operation of materials, products or equipment that will speed war production and help America fight—then you can perform a service to industry and to your country by participating in the War Production Edition of the National Metal Exposition—in Cleveland's Public Auditorium, Oct. 12 to 16, 1942, sponsored and managed by American Society for Metals in cooperation with the American Welding Society, The Wire Association, Iron and Steel and Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers.

The A.S.M. and cooperating societies join with the metal industry in dedicating their every effort for one purpose—Production for Victory.

Annual Meeting Combines Election, Astronomy Talk

Reported by James C. Erickson
Deere & Co.

Tri-City Chapter—Gordon T. Williams, metallurgist at Deere & Co., was elected chairman for the 1942-43 season at a meeting held April 14 at the Farmall club, Rock Island. Other officers will be listed in the August issue of THE REVIEW.

Following a smorgasbord dinner, a demonstration of jujitsu was given by Joseph C. Bronsby and two aides from the Davenport Y.M.C.A.

C. H. Gamble, manager of the John Deere Spreader works, East Moline, gave an illustrated lecture on astronomy. The speaker conveyed to the group the magnitude of the universe by comparing astronomical units of measurement with those in everyday use.

A.S.M. Members at Fifth Pennsylvania Inter-Chapter Meeting



Some of the 142 A.S.M. Members Who Registered for the Fifth Biennial Pennsylvania Inter-Chapter Meeting Held at State College on April 24 and 25. They are photographed on the steps of the Mineral Industries

Building of the Pennsylvania State College, joint sponsor of the meeting along with the Penn State, Philadelphia, Pittsburgh, York, Lehigh Valley, Northwestern Pennsylvania, and Southern Tier Chapters.

New West Michigan Chapter Formed In Grand Rapids

Reported by Herman Van Zyl
Keeler Brass Co.

The Grand Rapids Group of the Detroit Chapter of the A.S.M. met on April 20 in the English Room of the Rowe Hotel and voted to petition the Board of Trustees for a charter for a full-fledged chapter to be known as the West Michigan Chapter. Ray T. Bayless, assistant secretary from the Cleveland office, was present to guide the arrangements and give some helpful suggestions.

The necessary number of names on the petition was secured during this meeting and was transmitted to headquarters. Active membership is 68.

The program speaker was Adolph Koch of the Surface Combustion Corp., whose topic was "Heat Treatment in the Armament Program". He stated that our pioneering background makes it possible for us to turn out substitutes which will be our future standards.

For instance, by converting from brass cartridge cases to steel, American industries have saved approximately 700,000,000 lb. of brass. This process of cartridge making takes several anneals, most of which are done in bright annealing furnaces of the radiant tube type.

Many large shell manufacturers now use what is known as the walking beam type of furnace. This allows the shells to pass through the furnace in steps and at each step the shell is rotated slightly to permit uniform heating. Another advantage is that the furnace is self-emptying.

He also discussed different types of atmosphere control for alloy steels.

Thanks of the new Chapter were voted to Mr. Koch and Mr. Bayless for an interesting and informative evening.

Die Caster's Chief Concerns Are Best Alloys, Die Materials

Reported by H. T. Clark
Research Physicist, Jones & Laughlin
Steel Corp.

Pittsburgh Chapter—F. C. Barnes, industrial hygienist, Westinghouse Electric & Mfg. Co., was the coffee speaker at the April meeting. Speaking on "Plant Protection", he outlined the organization that has been set up both in industrial plants and residential sections to handle any emergency that may arise due to a direct attack by the enemy.

"Die Casting of Non-Ferrous Metals" was discussed by J. C. Fox, chief metallurgist of Doehler Die Casting Co., the principal speaker.

He described the methods used in die casting various alloys and traced the development of the present equipment from the earliest designs of machinery used for forcing molten metal into dies under pressure.

Much of the concern of the die caster is centered on two problems—both metallurgical in nature. He is interested in using the best alloy for the part being made and in making the die out of a material that will stand up under the load of thousands of operations without developing cracks, distortions and abrasions.

Die castings are made commercially from non-ferrous alloys containing as the major constituent one of the following metals—zinc, copper, aluminum and magnesium. The amounts of added metals or metallic impurities influence the static and dynamic properties as

Officiate at Launching of New Chapter



Photographed at the Organization Meeting of the New West Michigan Chapter Are C. H. Lloyd, Membership Chairman; Adolph Koch of Surface Combustion Corp., Speaker; and Ray T. Bayless, Assistant Secretary of the A.S.M.

Information on National Emergency Steels Found in Recent Metal Progress Issues

Shortages in the ordinary alloying elements for steel have caused the War Production Board to promulgate a list of "National Emergency Alternates" for the well-known S.A.E. steels. These alternate steels have restricted contents in manganese, chromium, nickel, and vanadium, and rely primarily on carbon, silicon and molybdenum for strengthening, toughening, and hardening.

Henry Marion Howe Honored at M.C.M.T.

Reported by I. J. Levinson
Michigan College of Mining and Technology

Michigan College of Mining and Technology Group—Norman O. Kates, for two years the dynamic president of the A.S.M. Chapter and of Alpha Sigma Mu, honorary metallurgical fraternity, formally announced his resignation from both posts at the annual A.S.M. banquet held at the Venice Cafe.

The meeting was the second in a series inaugurated last year for the purpose of honoring a famous metallurgist, this year the former professor of metallurgy at Columbia university, Henry Marion Howe.

The life and ambitions of Howe were depicted by Gordon Goodwin, who related various highlights in the prominent metallurgist's career. It was pointed out by Goodwin that Howe was one of the first men to realize the importance of cast iron in the field of ferrous metallurgy.

Other speakers of the evening were G. W. Boyd, the organization's faculty adviser, and Don Mathews, succeeding president.

Don Mathews and Jim McGrail will replace Kates as presidents of A.S.M. and Alpha Sigma Mu, respectively. Al Bender acted as master of ceremonies.

well as the aging characteristics of the resulting alloys.

Mr. Fox gave the composition of typical alloys used and discussed the advantages and disadvantages of each. The role of magnesium in the future is of particular interest because of its low weight per unit volume.

The modest way in which Mr. Fox described the industry and its activities was belied by the assortment of die castings that he brought to the meeting with him. He indicated that the items on display went out, in a large part, with the automobile but they served admirably to drive home the point that the die casting industry is capable of producing fully formed parts at high speed.

During this critical period when the cry is for more and more production, we should all be thankful for the existence of such a well-developed and active industry in our camp.

Robert M. Bird, Past President Of A.S.M., Dies

ROBERT M. BIRD, national president of the American Society for Metals in 1925-26, died May 10 of a heart attack in Niagara Falls while returning from a business trip to Canada. He was 59.



R. M. Bird

Mr. Bird was born in Bethlehem, Pa. and was graduated from Lehigh University with a degree in mechanical engineering in 1902. For 22 years he was in the employ of the Bethlehem Steel Co., where he served successively as superintendent of heat treating, superintendent of merchant mills, metallurgist, and engineer of tests.

He then became associated with George F. Pettinos of Philadelphia in the production and sale of foundry sands, supplies and graphites. In 1928 he became New York district sales manager for the Midvale Co., a position he held until the time of his death.

George L. Norris

GEORGE L. NORRIS, chief metallurgist of the Vanadium Corp. of America, died at Roosevelt Hospital, New York, on April 13. Mr. Norris was 76 years old.

He was one of the pioneers in the development and application of vanadium. He joined the American Vanadium Co. in 1909 and remained with this company when it became the Vanadium Corp. of America. He was in active service until the time of his death.

Mr. Norris graduated from Massachusetts Institute of Technology in 1887. After graduation, his business affiliations were with the Pennsylvania Steel Co., the North Chicago Rolling Mills, Illinois Steel Co., Pencoyd Iron Works, Reading Iron Co., Walter A. Wood Harvester Co., Great Northern Railroad, Laconia Car Co., McNeil Pipe and Foundry Co., and Standard Steel Works at Burnham, Pa., where he was engineer of tests.

Mr. Norris was chairman of the New York Chapter A.S.M. in 1921.



G. L. Norris

Substitute Steels
National Emergency Steels
List of Compositions—March 1942; p. 344.
(Revised S.A.E. and A.I.S.I. steels—March 1942, p. 345.)
Substitutions for Carburizing Grades—March 1942, p. 344.
Substitutions for Semi-Thorough Hardening grades—March 1942, p. 347.
Substitutions for Thorough Hardening Grades—March 1942, p. 348.
Substitutes for Nickel Steels—Sept. 1941, p. 300.
Manganese-Molybdenum Steels—Dec. 1941, p. 906.
High Strength Low Alloy Steels—Nov. 1941, p. 782.
Making the Most of Carbon Steels—Oct., 1941, p. 451.

Basis of Substitutions
General Considerations—Dec. 1941, p. 881.
Considerations Involving Shop Practices—Sept. 1941, p. 289.
Metallurgical Considerations—June 1941, p. 721.
Jominy's End-Quench Test; Method—Dec. 1941, p. 911.
Jominy's End-Quench Test; Interpretation—Nov. 1940, p. 685.
Jominy Curves for NE Steels—March 1942, p. 342.

The Alloy Situation
Function of Alloys in Steel—Oct. 1941, p. 464.
Supply of Manganese—Aug. 1941, p. 167; Sept. 1941, p. 295.
Molybdenum—July 1941, p. 44; Aug. 1941, p. 169.
Nickel—March 1941, p. 299; Sept. 1941, p. 295.
Chromium—Sept. 1941, p. 294; Oct. 1941, p. 676, 686; April 1942, p. 503.
Vanadium—Sept. 1941, p. 297.

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Chicago Chapter ASM-WPAC

George A. Spencer, Chairman
Crown Rheostat & Supply Co.

EXECUTIVE STAFF: J. L. Burns, Booz, Fry, Allen & Hamilton; K. H. Hobbie, Driver-Harris

BECAUSE so many metal problems are involved in war-time production, the local chapters of the American Society for Metals have organized War Products Advisory Committees as a free advisory service for the metal producing and metal working industries. These ASM-War Products Advisory Committees will meet regularly. Every manufacturer of war products is invited to avail himself of these meetings.

If you have a problem, do not hesitate to get in touch with your local committee. Write or phone the coordinator, chairman, secretary or problem recorder as indicated in the list of committees on this page.

The work of the ASM-War Products Advisory Committees is solely a contribution to present war-time efforts. You need not be a member of the American Society for Metals to obtain this service. *You will not be solicited for membership.* This is a sincere effort on the part of the chapters of the ASM to make a valuable contribution to "Ultimate Victory".

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Tri-City Chapter ASM-WPAC

H. N. Bristow, Chairman
Deere & Mansur Works
Moline, Ill.
Moline 3400

Jerseymen Examine German Air Engine; Comparisons Given by Young and Clements

Reported by Fred P. Peters
Managing Editor, Metals and Alloys

New Jersey Chapter—If the quality of materials, finish and general metallurgical design of German fighter-plane engines is a valid criterion, the Nazis are not going to be any pushover in this man's war!

That was practically the unanimous opinion of the capacity crowd of nearly 300 members and guests who, on March 16, personally examined a Mercedes-Benz DB-601-A engine (sorry, no souvenirs!) and listened to Raymond W. Young and Bishop Clements, chief engineer and chief metallurgist, respectively, of Wright Aeronautical Corp., Paterson, describe its mechanical and metallurgical features and compare them with those of contemporary American engines.

Ordnance District Activities Carried by Seven Sub Offices

Reported by Edward Troy
Inland Steel Company

Calumet Chapter—"Activities of the Chicago Ordnance District" was the subject discussed by Lieut. Col. William J. Mather, executive officer of the Chicago Ordnance District, at the March meeting.

The Chicago Ordnance District, one of 13 in the country, covers the industrial phase of procuring ammunition, small arms, tanks and combat vehicles, bombs, artillery, and other items for the United States Army from seven midwestern states. Many of its activities are decentralized into seven sub offices.

The planning division of the District was set up in 1922 to study the facilities of industries in order to determine what ordnance items could most easily be produced in the different plants.

The contract division is charged with determining costs and negotiating contracts with private manufacturers. Contracts ordinarily give considerable freedom to the plant when first written so that preparation for production will not be slowed down; after the plants get going contracts are renegotiated.

The inspection division is the largest of those in the Ordnance District, having about half of the total of 3200 employees. This division must be sure that material meets specification and likewise that the manufacturer is treated fairly.

The traffic and storage division is responsible for shipment of materials.

Colonel Mather stressed the importance of the work metallurgists carry on both in peace and wartime. The metallurgist should feel that in doing his job well he is filling his rightful place in the present emergency.

The German engine, which was brought down by a British machine-gun bullet in the main bearing, was shown by Mr. Young to be on a par with contemporary power plants of the same general type with respect to output, fuel consumption and weight.

The mechanical design ("frozen" for this engine in 1938) represents good mass production practice for military aircraft engines, he declared. As to workmanship and finishes, no useless effort was spent on any engine parts that brought no direct return in improved reliability and performance.

Germans Use Magnesium

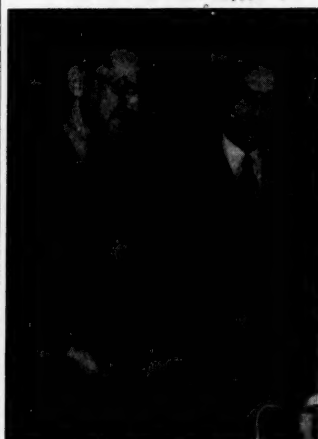
Much interest centered around the metals used throughout the German engine, and particularly the composition of some of the parts, on which Mr. Clements reported; many parts have yet to be analyzed, but enough has been done to date to give a fair picture of German metallurgical design for this engine.

Contrary to the first reports about this engine that appeared last spring, it does employ a considerable amount of magnesium, but not in the crankcase or cylinder blocks. Magnesium alloy castings (chiefly 7 to 9% Al, 1% Zn) are generously used—e.g. in the supercharger housing and oil pump bodies. The alloy contains less zinc than the magnesium casting alloys popular over here—the German alloy is a better casting material, but less corrosion resistant.

The wrought aluminum alloys used throughout the engine are generally of the duralumin type. Pistons are forged from an alloy similar to the standard American aluminum alloy containing 12% silicon.

The German valves are smaller than ours, and the hollow head is much harder to form. The DB-601-A exhaust valve (13.5% Ni, 15.5% Cr, 4% W, 1.5% Si, 0.45% C) is as good as our best; the

Gen. McFarland Talks



General Earl McFarland, Assistant to Chief of Ordnance, U.S.A., Discusses His Talk Before the Boston Chapter With Chairman George Burnett

seat is stellite and the stem is internally (sodium) cooled.

The German cylinder liners are made of a 1.5% Cr, 0.30% Ni steel, and are relatively soft (about Rockwell C-22). American engines employ hardened or nitrided cylinder barrels at about 900 Vickers hardness.

Chromium Is Absent

The valve springs on the Nazi machine are of the carbon-vanadium type. The hardnesses are about the same as American springs, but the absence of chromium in the German composition doubtless reduces the strength and fatigue properties.

The DB-601-A crankshaft is a 2.25% Ni, 2.25% Cr, 0.25% Mo, 0.20% C analysis, with a core hardness of Rockwell C-36, case hardness of C-60 and case depth 0.11 in. The Cyclone crankshaft contains much less alloy and higher carbon with a hardness that is substantially lower than the German. The bearing surfaces on the DB crankshafts are evidently induction hardened.

In some cases the Germans seemed fabulously prodigal. For example, connecting rod bolts on the DB-601-A contain much more alloy than is necessary; many other bolts, studs and nuts are of a steel similar to our S.A.E. 4100, although the Germans do not seem to have standardized on analyses and hardness as we have.

Cincinnati Chapter Invites Electroplating Societies

Reported by Michael Field
Cincinnati Milling Machine Co.

Cincinnati Chapter—Members of the Electrochemical Society and the American Electroplaters' Society were invited to attend the regular meeting on April 9.

Chairman George H. Gerdes introduced to the group R. Knoepfer and Al Foreman, president and secretary respectively of the American Electroplaters' Society; and John Davenport and E. H. Gast, president and secretary respectively of the Engineers' Club of Cincinnati.

Dr. A. J. Smith reported on the Tri-Chapter meeting to be held in Cincinnati June 5, and the speaker for the evening, William B. Stoddard, Jr., of the Champion Paper and Fiber Co., was then introduced.

Mr. Stoddard's subject was "The Electrodeposition of Metallic and Non-Metallic Substances", and covered copper, nickel, chromium, cadmium, zinc, iron and rubber.

Boston Has Joint Meeting With Army Ordnance Post

Reported by Paul Ffield
Materials Engineer, Bethlehem Steel Co.

Boston Chapter—The fifth annual joint meeting with the Boston Post of the Army Ordnance Association was held on Friday, April 10. The two societies took over the 14th floor of the Chamber of Commerce building and sponsored a comprehensive exhibit of ordnance material.

The exhibit was under the direction of Major H. W. Bagnell, U. S. A., assisted by Horace Ross of the A.S.M. Boston Chapter Executive Committee. Many examples of ordnance equipment were exhibited together with major components of 37-mm. guns and small mortars. The exhibit was essentially a Yankee exhibit, since all the equipment had been manufactured in the immediate vicinity of Boston.

After dinner, Chairman George Burnett introduced the honored guests representing the U. S. Army and Navy, and Lt. Col. Clark S. Robinson, U.S.A.R., then introduced the speaker, Brig. Gen. Earl McFarland, U. S. A.

General McFarland, who is assistant to the chief of ordnance, spoke on ordnance procurement, and showed how the army is relying on metallurgical developments to conserve strategic elements.

After dinner, the members adjourned once more to the Ordnance Exhibit where army men were available for a discussion of manufacturing and metallurgical problems.

Gray Cast Iron Is Shown as Economical Engineering Material

Reported by H. E. Hostetter
Metallurgical Engineer, Climax Molybdenum Co.

St. Louis Chapter—A deserving material, but one often neglected at A.S.M. gatherings, received attention at the March meeting when J. F. Robb, Climax Molybdenum Co., Pittsburgh, ably discussed "Gray Cast Iron—An Economical Engineering Material".

The properties of gray cast iron are controlled chiefly by the amount, type, size and distribution of the various carbon formations which in turn are controlled by such factors as: (a) The chemical composition, (b) the make-up of the charge, (c) the melting process, (d) the thermal and mechanical history from the furnace to the cooled casting (e) subsequent heat treatment. With all other factors held constant the properties are dependent upon the chemical composition.

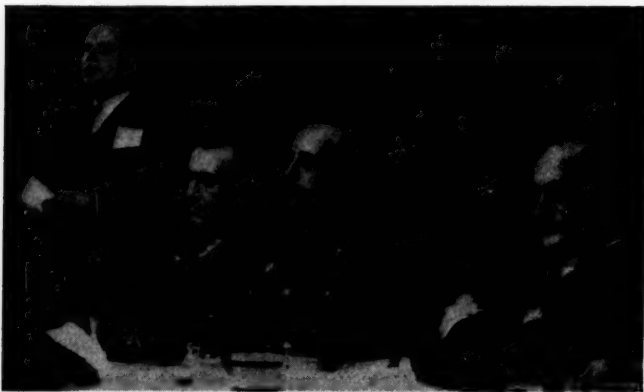
In cooling from the liquid state to room temperature the reactions of solidification, precipitation, solution and graphitization are involved. The course of the reactions determines the structural components of the iron.

Commercial cast irons contain as major structural components graphite, pearlite, ferrite, steadite, and cementite, each of which has certain characteristic properties. It can be readily appreciated that as the structure is modified, so too are the properties.

Since control of structure and hence properties by means of composition is one of the factors capable of a fair degree of manipulation, the effects produced by the usual elements and alloying elements is worthy of consideration.

Mr. Robb presented excellent qualitative and quantitative summaries of the major effects of various elements and some specific applications.

F.B.I. Agent Gives Coffee Talk at Calumet



R. H. Klett (Left), Federal Bureau of Investigation, Is Shown Giving the Coffee Talk Before the March Meeting of the Calumet Chapter. Seated next to him are D. E. Wilson, Chapter chairman; Lieut. Col. William J. Mather, executive officer of the Chicago Ordnance District, who gave the principal address; and L. S. Marsh, technical chairman of the meeting.

Sykes Defines Hardness as Basis of Alloys

Reported by Gerald M. Cover
Associate Professor of Metallurgy
Case School of Applied Science

Cleveland Chapter—One of the local members, Dr. Wesley P. Sykes, addressed the March meeting on the subject of "Hard Alloys".

He defined the term hardness from the standpoints of resistance to permanent deformation, resistance to fracture under compressive load, and resistance to abrasion. Methods of increasing the hardness of metal by plastic deformation (cold work), formation of solid solutions, and combinations of the two were discussed.

It was pointed out that iron, nickel, and cobalt form the bases of the hardest of the solid solutions, and that probably the hardest of these are with tungsten or molybdenum as solutes.

The next method of increasing hardness considered is by means of precipitation from supersaturated solid solution. In alloys of this type the temperature of the precipitation treatment is relatively high, namely, 600 to 800°C. The speed of hardening, maximum hardness, and resistance to softening by over-aging vary with the combination of alloying elements used.

Resists Over-Aging

The alloys of tungsten in nickel are perhaps outstanding examples of resistance to softening by over-aging at such temperatures as 800 to 900°C.

The ability of an alloy to withstand over-aging is a fair index of its "hot hardness". This latter property is of extreme importance in an alloy used for tools and dies for hot forming.

Hardness thus far has been considered from the standpoint of resistance to permanent or plastic deformation. Even the hardest of such materials are considerably softer than such metallic compounds as the carbides, nitrides, and borides, or the natural crystals of the minerals corundum, topaz, and diamond.

These compounds do not deform plastically, and their hardness must be determined by some other methods, such as scratch hardness or Bierbaum micro-character. A method has recently been developed to determine quantitatively the resistance to abrasion by lapping with some standard abrasive.

Preparation of Carbides

Considering tungsten carbide, it can be formed by carburizing the surface of solid tungsten, or pieces of some size can be made by melting carbon and tungsten. The hardness of such carbides, however, is used to best advantage in so-called cemented carbides.

The powders are mixed, pressed, and heated to sinter them into the form of a crystalline metal. Cobalt is added to the powdered mix as a binder, and forms a tough matrix for the hard carbide. Substitution of tantalum or titanium carbide for part of the tungsten carbide has more effect upon other properties than upon hardness.

Both tantalum and titanium carbide improve the performance of tools in cutting steel, as they diminish the welding action between the work and the tool tip.

Tungsten carbide and titanium carbides form a solid solution when mixed as powders and heated above 2000°C. There is no evidence of increased hardness when used as the carbide with cobalt as a binder.

Solid solution hardening, therefore, is probably inoperative when no plastic deformation is possible.

HERE AND THERE WITH A. S. M. MEMBERS

R. H. Co. has announced the election of JOSEPH L. AUER as vice-president and general manager.

Mr. Auer, formerly secretary of the New Jersey Chapter A.S.M., has been general works manager since he joined the R. Hoe organization in 1937. He was formerly superintendent of the Crocker-Wheeler Electric Mfg. Co., and works manager of the De La Vergne Machine Co.

Mr. Auer has been active in anti-aircraft defense program and is currently chairman of the Army Ordnance Anti-Aircraft Carriage Committee.

DUQUESNE Smelting Corp. has announced the appointment of JAMES F. EDNIE as chief metallurgist of the technical and metallurgical department.

Mr. Ednie was formerly associated with the metallurgical and research department of the Federated Metals Division of American Smelting and Refining Co. and has had wide experience in metallurgical and research work. Other connections have been with Westinghouse Air Brake, Carnegie-Illinois Steel, and Union Switch and Signal Co. He is a graduate of Carnegie Institute of Technology, holding a degree in metallurgical engineering, and is a member of the Pittsburgh Chapter A.S.M.

LIEUT. GEORGE B. MUNROE, 1940 graduate in metallurgical engineering from Missouri School of Mines & Metallurgy, where he was a member of the local student A.S.M. group, is reported safe in Australia after some harrowing experiences.

Lieut. Monroe was navigator on a flying fortress which was forced down in the jungle on an island near Australia. The plane had successfully attacked a Japanese transport and shot down two out of five attacking Japanese aircraft, but ran out of gas on the return trip and had to land in a swamp. The crew of seven was near death many times and reported some hair-raising

Australian Member Visits Hartford; Leiter Speaks

Reported by J. T. Ballard
Quaker Chemical Products Co.

Hartford Chapter—National Secretary W. H. Eisenman was in town for the April meeting. He entertained 12 of the Executive Committee at a luncheon at the Bond Hotel, at noon, produced some particularly well chosen paragraphs at the dinner at the City Club and later gave the boys another treat by presenting to the Hartford Chapter its replica of the President's Bell.

An added attraction and unexpected guest was Arthur P. Downes of the Gilbert Lodge & Co., Ltd., of Melbourne, Australia.

The main speaker of the evening was Ralph W. Leiter, research metallurgist of the Edward G. Budd Mfg. Co., of Philadelphia. His subject was "Deep Drawing and Forming of Sheet and Strip Steel".

Dr. Leiter's talk, though based on very technical data, was a very interesting one even from the standpoint of the layman. He accomplished this very handsily by the use of a fine selection of slides showing in production scenes the results of highly technical developments and analysis.

experiences in attempting to hack their way out of the jungle before they were finally rescued many days later.

AT THE annual meeting of the shareholders of Jenkins Bros., Ltd., held recently in Montreal, BERNARD COLLITT was elected a director of the company. He has been metallurgist with Jenkins Bros. for the past 12 years.

Mr. Collitt was born in Lincoln, England. After a thorough training in chemistry in London, he studied metallurgy in Sheffield and in Germany and came to Canada in 1909. During World War I he was chief chemist and metallurgist with Ruston & Hornsby Ltd. of Lincoln, England.

Mr. Collitt has long been active in the Montreal Chapter of the A.S.M., serving as chairman in 1937-38.

CHARLES M. CRAIGHEAD has been named a research metallurgist on the staff of Battelle Memorial Institute, Columbus, Ohio.

Mr. Craighead was formerly associated with the Aluminum Co. of America, the Reynolds Metals Co., and the Braeburn Alloy Steel Corp. He is a graduate of Pennsylvania State College, a member of the American Society for Metals, the American Chemical Society, and Phi Lambda Upsilon, honorary chemical society.

Rochester Hears About Plastics and ASM-WPAC's

Reported by J. M. Keating
Camera Works, Eastman Kodak Co.

Rochester Chapter—The April meeting was honored by the presence of our esteemed national secretary, "Bill" Eisenman. He discussed the good work being accomplished by the A.S.M.-W.P.A.C. in the chapters that have organized for this service and predicted for it a greater usefulness in the war effort.

The technical speaker was Garson Meyer, chief chemist, Camera Works, Eastman Kodak Co., on "Basic Materials in the Plastic Industry".

There was a wide variety of new applications on display, indicating the trend in the plastic field. Great interest was shown by the metals men as testified by the lengthy discussion which followed.

Compares Hardenability Of Old and New Steels

Reported by V. C. Leatherby
Eclipse Fuel Engineering Co.

Rockford Chapter—Once again R. S. Archer, metallurgist for the Republic Steel Corp., appeared before the Chapter to speak at the April meeting.

During the business meeting the Nominating Committee announced the slate of officers which will be voted upon at the next meeting. Several new members were introduced, and tentative plans for the picnic announced.

Mr. Archer reviewed the various alloys which have been limited by the defense program and discussed some of the substitutes that have been offered. A comparison of the old and new steels was made from a hardenability basis with tabulations shown on slides.

Various heat treatments for some of the new steels were discussed in answer to questions from several members.

Seamless Tube Described as Elongated Hole

Reported by Ellis Blade
Consulting Engineer

New York Chapter—A. J. Williamson, chief metallurgist of the Sumner Tubing Co., addressing the Chapter on March 9 on the subject of "Seamless Tubing", described a tube as an "elongated hole".

Early welded tubing was partially replaced nearly a century ago by seamless tubing made by a cupping method, while in 1895 the Mannesmann brothers patented the forerunner of the present process.

When the red-hot billet is passed between the crossed forging rolls, the interior spontaneously opens up to form a hollow. The rolls simultaneously rotate the billet and force it forward over a pointed plug, which opens the hole to a smooth, round cavity.

Four Kinds of Cold Drawing

The tube is then hot-reduced in separate operations. The final size and finish are obtained through cold-drawing, of which there are four kinds—plug drawing, rod drawing, sinking, and the Rockrite process.

Among the metals that have been successfully drawn are all the straight carbon steels, the S.A.E. 4100 series, the nickel-molybdenum steels, pure nickel, monel, beryllium-copper, and others. Stainless steel, which presents unusual difficulties, is pierceable only in certain compositions.

Low carbon steel tubing is used for spinning and flaring applications, and for high pressure use such as diesel fuel-injection lines (10,000 psi.). Alloy steel tubes find application in fish-poles, radio antennae, ski-poles, and golf shafts.

Where a protective metal is needed outside or inside, two metals may be drawn together to form composite tubing. For example, silver, copper, nickel, or stainless steel may be used to cover steel.

Bourdon and other spring tubing for precision applications in pressure-operated instruments requires accurate sizing and uniform wall. Corrosion resistance may be specified toward water, steam, mercury, gases, or chemicals.

Hypodermic Needles Cold Drawn

Capillary tubing for thermometric systems, of 1/16 in. OD and 6 mil ID, is made in 500-ft. lengths from stainless steel, type 347. The bore must be absolutely clean and uniform.

Hypodermic needles, of austenitic stainless or medium carbon alloy steel, are cold drawn from an original 1 or 1 1/2-in. diameter to the finished size of 0.012-in. OD, 0.006-in. bore, and 0.003-in. wall. Since, in stainless steel, the hardening can only be produced by cold work, the amount of cold reduction must be carefully predetermined.

Aircraft tubing, formerly made of S.A.E. 1025, is now made almost entirely from X4130, to obtain higher strengths.

J. P. Dods, responding to a question after the lecture, explained the use of square aircraft tubing. In fabrication of built-up trusses, the longitudinal members—or longerons—are made of square stock, to simplify scarfing in of secondary members prior to welding together.

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Shows Silver Solder



John L. Christie of Handy and Harman (Left) Explains the Intricacies of the Silversmith's Art to Al Gobus, Vice-Chairman, New York Chapter.

Christie Describes Silver Brazing Alloys

(Continued from page 1)

to meet the legal standards for fineness.

The Ag-Zn series, like the familiar Cu-Zn series, is malleable from 100 down to 70 Ag. The Cu-Ag alloys, with a eutectic at 72 Ag, are malleable and ductile throughout.

Melting points of the common alloys, containing more copper than zinc, decrease with increasing silver. The 10 Ag alloy, melting at 1600° F., is used for joining iron, steels, and high melting non-ferrous alloys. The 20 Ag grade, flowing freely above 1500° F., is good with copper-base alloys, steel, and iron.

The typical silver brazing alloys, in the 40 to 50 Ag range, used for many years, are malleable, ductile, free-flowing, corrosion resistant, and fairly shock-proof. The 60 Ag grade, flowing at 1325° F., is used where low temperatures are desirable for preventing grain growth.

The silversmiths' solders are the 65 (easy), 70 (medium), and 75 Ag (hard) grades. The 80 Ag alloy, an extremely ductile and malleable white alloy, is particularly satisfactory in joining copper rods for wire drawing.

Addition of cadmium to the 65 Ag grade raises the liquidus, but if Ag is decreased to 50% the quaternary eutectic is approximated. This alloy, called Easy-Flu, melts in the range 1160 to 1175° F.

The latter part of Mr. Christie's talk covered the proper method of heating silver-brazed joints, and included a thorough discussion of fluxes.

He demonstrated a striking feature of the silversmiths' art by exhibiting the skill they have in soldering together the various parts of hollow-ware. First displaying a graceful coffee pot for everyone's admiration, he indicated the many invisible soldered seams, and then showed how the 11 component parts are successively joined together.

Personnel Problems Seen In Large Ordnance Staff

Reported by Irvin J. Rapp

Gas Engineer, Dayton Power & Light Co.

Dayton Chapter—Major Geo. M. Enos (since promoted to the rank of lieutenant colonel), Cincinnati Ordnance District, presented a talk on "Ordnance Inspection" on April 8.

He discussed the problems involved in building up the present large group of ordnance inspectors from the very small number of two and three years ago. The main points covered were the selection of personnel, the general and special training given them, and the requirements of a good inspector as to technical and mechanical ability as well as personality.

Inspectors must inspect according to the terms of the contract, drawings and

Students Speak At University Meeting in Cincinnati

Reported by G. F. Baumann

Tool Engineer, Gruen National Watch Case Co.

Cincinnati Chapter—The third annual University Meeting was held at the University of Cincinnati in March. Lectures were given by student speakers selected by Prof. R. O. McDuffie and J. F. Kahles, faculty members of the metallurgy division.

Martin F. Littmann, graduate student, presented a paper based on his thesis on "Copper-Manganese Alloys". As an undergraduate his thesis won the Hochstetter Prize and also a \$200 second prize in the national 1941 Electro-Manganese Corp. contest.

Lewis W. Alexander, senior metallurgy student, spoke on "Tungsten, Titanium, and Tantalum Carbides" with particular stress being placed on the multi-carbides of tungsten and titanium now used in steel cutting.

Cu-Mn Alloys Studied

The high purity alloys of copper with electrolytic manganese, according to Mr. Littmann, form a series of solid solutions which are soft and malleable when quenched from temperatures near their melting points. Heat treatment at temperatures up to 700° C. revealed interesting age hardening phenomena for alloys containing 30 to 74% manganese. The range of compositions studied was 25 to 74% Mn.

Slides were shown of typical microstructures demonstrating the effect of time and temperature on the Widmanstätten precipitate. These photomicrographs were correlated with corresponding hardness curves. A method was described for polishing these alloys electrolytically.

Mr. Alexander emphasized in his presentation that the difficulty of obtaining finely divided carbide particles having the desired physical structure, and of retaining the high surface activity of these particles until the bonding is completed by pressing and sintering, has led to some highly special techniques.

WTiC: Improves Carbides

The manufacture of macro-crystalline carbides by heating the refractory metals or their oxides with carbon under a bath of molten metal, and the subsequent separation of the crystals from the metal menstruum in which they were formed, has greatly improved steel cutting sintered carbide tools.

In particular, the use of the compound, tungsten titanium carbide, which is a macro-crystalline carbide corresponding to the formula WTiC, imparted very desirable properties to the final sintered carbide. The resistance to flow of the continuous chip produced in cutting steel, and the thermal conductivity and the tendency to cratering were all reduced, while the strength and the hardness at red heat remained high.

The session was brought to a close following an inspection tour through the metallurgy laboratories.

specifications, unless written waivers are received from proper authority.

The movie "Heat Treating Hints" produced by the Lindberg Engineering Co. was also shown.

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Address answers care A. S. M., 7301 Euclid Ave., Cleveland, unless otherwise stated

Positions Open

CHEMIST: To assume charge of chemical department of metallurgical laboratory engaged in defense work. At least five years' experience in analysis of ferrous and non-ferrous metals; should be generally familiar with metallurgical testing methods. Give age, education, experience and salary desired in first letter, with photo. Must be citizen of U.S.A. Location Pennsylvania. Box 5-5.

NON-FERROUS CHEMIST: Experienced man for permanent position in analysis of brass, bronze, bearing metals, aluminum, and magnesium. Knowledge of ferrous, organic, and miscellaneous analysis desirable. State in first letter full experience, background, and approximate salary expected. Middle west location. Correspondence strictly confidential. Inquiries desired from qualified applicants only. Box 2-5.

METALLURGIST: Young graduate with practical knowledge of the processing of stainless steels. Should be competent in metallography and experienced in the investigation of metallurgical problems of stainless steels in production and in the field. Give training and experience. Box 4-10.

RECENT GRADUATE in metallurgy for laboratory and field work in connection with furnace development. All details and photograph in first letter. Prominent furnace manufacturer now 100% defense work, but position would be permanent and offers a wonderful opportunity to man who can qualify. Box 5-30.

METALLURGICAL ENGINEER: Young, to act as service engineer for Detroit firm. Should have some experience in heat treatment of steel. Position will require some traveling and a certain amount of laboratory development work. Needed immediately. Box 5-35.

REPRESENTATIVE: Philadelphia area, to sell heat resisting alloy castings. Sales organization now handling corrosion resisting alloys. Box 5-45.

BUSINESS MEN: There is an urgent need in the Government for men with business experience in the production of machinery and machine tools. Applicants must have such experience as insures their familiarity with production processes, and with the economic structure of the industry represented. Experience as a sales engineer may be considered qualifying for some of these positions. College education desirable but not required. Ask for Form 8 (or Form 57) and Form 4006-ABCD at any first or second class post office.

SUPERVISOR: For heat treating plant. Age 35 to 40; knowledge of commercial heat treating practice; capable of planning and carrying

through production and specialty schedules. Will have skilled shop men to work with. Give references and details of experience. Eastern location. Box 5-55.

METALLURGISTS: Needed urgently by arms manufacturing company for two plants in east and one in midwest. Both process and research metallurgists. Should be particularly posted on copper. Salary \$4000 to \$5000. Box 5-60.

Positions Wanted

METALLURGICAL ENGINEER: M.Sc.; four years of practical experience in responsible metallurgical control in ferrous field, research and production work, including open hearth, rolling mill, heat treating, forging, blast furnace and foundry. Location far west. Box 5-10.

RESEARCH ENGINEER: Over ten years' experience in large industrial research laboratory in development and initial laboratory production of highly alloyed materials for special uses. Desires position in an industrial research laboratory or university with research facilities. Western location preferred. Box 5-15.

CHIEF METALLURGIST: In medium sized organization, or chief assistantship considered. Over 12 years' control and research experience in ferrous and non-ferrous metals, principally in castings field. Seven years in supervisory capacity. Permanency of position and salary commensurate with training and experience desired. Highest references. Box 5-20.

METALLURGICAL PHYSICIST: Ph.D., non-ferrous; 12 years experience in research and development. Light machinery, new products, manufacturing processes. Would like responsible supervisory position. Age 36. Box 5-25.

CHEMIST: Draft exempt. Nine years' analytical and 4 years' engineering experience in non-ferrous, ceramic and iron and steel lines. Desires connection where careful, accurate work and painstaking effort will count. Investigation and development work in non-ferrous metals and alloys preferred. Box 5-40.

FERROUS METALLURGIST: 16 years' thorough, practical experience in open hearth, mills and laboratory work. Capable of directing metallurgical department or research work. Minimum salary \$6500. Age 42. Box 5-50.

METALLURGIST: Age 30, M.S. in chemical engineering. Present position assistant professor teaching engineering courses in heat treatment and physical metallurgy. Would like position handling plant metallurgical work. Detroit, Chicago, Cleveland or Buffalo area preferred. Salary about \$500 per month. Box 5-65.

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